



Be Inspired Awards
2012 Finalist

Project Summary

Organization

Parsons Brinckerhoff

Solution

Rail and Transit

Location

Glenfield, Australia

Project Objectives

- The South West Rail Link aims to improve the reliability and increase capacity of the rail network in south west Sydney.
- Phase 1 upgraded the Glenfield Station and bus/rail interchange, and added rail flyovers to the north and south.
- The Glenfield Junction Alliance is developing all rail works within a live rail corridor while maintaining passenger and freight operations.

Products Used

- ProjectWise, MicroStation, Bentley Rail Track, InRoads Suite, Bentley Architecture, Structural Modeler

Fast Facts

- Parsons Brinckerhoff provided design services for all elements of the civil works and rail systems.
- Bentley software enabled engineers to implement design best practices for steep grades, limited space, construction costs, and constructability.
- 3D models of track, piling, walls, structures, and under-track crossings were combined to form 4D construction simulations.

ROI

- 3D information modeling enabled the Alliance to save AUD 1 million in design and construction costs.
- Standardized preferences and automated routines in Bentley Rail Track accelerated drawing production, generating a total savings over 150 drawings, of 1,500 man-hours.
- Bentley products contributed to an acceleration of construction time of up to one year.



Information Mobility Helps Deliver Award-winning Project

Integrated 3D Modeling Using Bentley Software Enables Design and Construction of Phase 1 of Sydney's Rail Expansion Program

Upgrading Rail Transport in New South Wales

The South West Rail Link (SWRL) is a New South Wales (NSW) Government initiative designed to address reliability issues and a projected increase in ridership on the metropolitan rail network in Sydney, Australia. The AUD 2.1 billion project includes a major upgrade of Glenfield Station and bus/rail interchange (Phase 1), and a new 11.4 kilometer twin-track passenger rail line from Glenfield to Leppington (Phase 2).

Parsons Brinckerhoff, a global infrastructure strategic consulting, engineering, and program/construction management organization, designed the majority of Phase 1 works as a member of the Glenfield Junction Alliance (GJA). Three-dimensional modeling using Bentley Rail Track, Bentley Structural (now Structural Modeler), and other Bentley products enabled the Alliance to save nearly AUD 1 million in design and construction costs as well as accelerate project delivery.

Opened in September 2012, four months ahead of schedule, the refurbished Glenfield Station includes a new aerial concourse, lifts, ticket office, bus interchange, and parking lot; and upgraded platforms and canopies. The transport interchange has already improved accessibility, reliability, and capacity for commuters in the area. On track for completion in 2015, the SWRL will provide essential infrastructure for Sydney's 18-precinct South West Growth Centre – with modern, safe, and accessible stations and interchange facilities for all rail commuters.

Building in a Congested Live Rail Corridor

Growing rail capacity to meet demand is the responsibility of the integrated transport authority known as Transport for NSW, a NSW government agency reporting directly to the minister of infrastructure and transport. Transport for NSW is also working closely with rail operator Sydney Trains to bring the SWRL project into operation. Transport for NSW formed the GJA that consisted of Parsons Brinckerhoff Australia, John Holland, and Bouygues Travaux Publics.

GJA's scope of work was to design all elements of the civil works and rail systems, and to construct all civil works except for those within the three-meter "danger zone" around the live railway. Track and rail system construction within the danger zone were the responsibility of Novo Rail (an alliance of Transport for NSW in partnership with Aurecon, Laing O'Rourke, and ODG Haden).

Phase 1 works not only upgraded the existing bus and rail interchange at Glenfield Station but also constructed rail flyovers to the north and south of the station. The improvements provided essential infrastructure and added capacity for a population center projected to grow by 300,000 over the next 30 years. The Alliance designed the rail systems (permanent way, signaling, communications, and overhead wiring), station structure and flyover structures, road realignment and associated works, high voltage systems, and earthworks and retaining walls. GJA was also involved in environmental and sustainability management, community and stakeholder relations, and systems assurance.

The major challenge for the Alliance was constructing the SWRL infrastructure within a congested live rail corridor while maintaining passenger and freight operations. GJA built as much of the infrastructure as possible outside the danger zone and within track possessions where required. Staging



All civil construction works, except those within the three-meter "danger zone", were undertaken in a congested live rail corridor.

“One of the biggest value adds of Bentley software was the ability to integrate 3D models for each discipline. This type of information modeling allowed the different disciplines within the project team to effectively communicate design details and updates during design and construction phases.”

– Mike Jenkins, Alliance Leadership Team, Glenfield Junction Alliance

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construction to ensure safe rail operations was a multidiscipline effort among Alliance members, representing more than 1,000 professionals.

Information Modeling Enables Design Improvements and Aids Constructability

During the project definition phase and as part of the optioneering and value engineering process, the project team scrutinized various solutions for the flyovers and station structures. Multiple iterations of the track alignment and structure were produced before the optimal design was chosen. A major benefit of using the Bentley suite of products was the ability to easily integrate 3D models. Stuart Allabush, Parsons Brinckerhoff senior track design engineer, noted: “During the design development of the southern flyover, the structural engineer identified a number of design improvements that were modeled in 3D using Bentley software. Information modeling in this way resulted in amendments that saved up to AUD 1 million in design and construction costs.”

Information mobility and the integration of 3D models also benefited cross-discipline relationships involved in the construction of the flyover structures. The project team combined 3D models of track, piling, walls, structures, and under-track crossings to form 4D construction sequence simulations, allowing team members from different disciplines to detect and avoid clashes, as well as confirm constructability of different elements of the design in the congested rail corridor.

Interactive 3D PDFs used to communicate design updates to the project team and the client were well received. Allabush explained: “The 3D PDFs were used to show the client how the project would fit in the corridor, how it would be built, and what it would look like during each phase of construction.”

In other areas, 3D models shared among structures, track, and earthworks team members enabled the interfaces between structures to be optimized. Bentley Rail Track was used extensively to design trackwork and embankments in the vicinity of the north and south flyovers. The 3D rail design and maintenance software was also used to evaluate staging options, detect clashes between designs, ensure clearances, and identify construction methods.

Four track staging designs were developed using Bentley Rail Track in order to implement temporary designs before the final

alignments were achieved. Upon completion of the detailed design phase, approximately 4,000 drawings were produced for 160 design packages.

Using Bentley Rail Track and Automation Routines Saves Time and Ensures Accuracy

For the track design, Parsons Brinckerhoff configured Bentley Rail Track’s preference files to ensure both consistency of output, and compliance with track standards, for all track drawings. “The operator, Sydney Trains, has very prescriptive ways of showing their designs, so we adapted Bentley software to produce the details in the required format,” explained Allabush.

“All kilometrages and coordinate information adjacent to the line were produced from the standardized preference file in Bentley Rail Track, ensuring the information was in the correct position, using the right font and size, as required,” added Allabush.

Parsons Brinckerhoff also wrote custom VBA (Visual Basic for Applications) routines that extracted data directly from 3D design in Bentley Rail Track, and then placed information such as the details of each individual curve element, turnouts, and alignments, onto the drawings. “We tried to remove the risk of human error in this process as much as possible, by reading directly from the model. If the model is approved as correct, then it follows that any details on the drawing derived from it will be too,” noted Allabush. “The routines we developed really came into their own when we made an alignment change. It’s relatively easy to get a drawing right the first time, but when you change it, that’s when mistakes can creep in. With the use of these tools, the effect of design changes rippled through to the drawings and the risk of errors mitigated as a result.”

The combination of automation routines and Bentley Rail Track’s standardized preference file allowed Parsons Brinckerhoff to save approximately 10 hours of design and CAD amendment time per drawing, generating a total saving across the 150 drawings required of 1,500 man-hours.

On a large-scale project like SWRL, such efficiencies can shave weeks off the schedule. Phase 1 was completed four months ahead of schedule, and Phase 2 is also progressing faster than anticipated. “The current construction program is proposed to be accelerated by up to a year,” said Allabush. “This is in part due to the quality and flexibility of Bentley products used on the project.”



Construction of the Northern Flyover approach ramp at Glenfield Interchange.



A visualization of the Glenfield Transport Interchange Station elevation.